SPECIAL SOFTWARE FOR PILOT TRAINING

Arinicheva, Olga V., *St. Petersburg State University of Civil Aviation, St.Petersburg, Russia.*
Vlasov, Evgeny V., *NITA company, St. Petersburg, Russia.*
Grehov, Vadim A., *graduate pilot of St. Petersburg State University of Civil Aviation, St. Petersburg, Russia.*

ABSTRACT

The article is devoted to description of methodological problems, occurred during application of special software package intended for training civil aviation personnel within the program «CRM – two-man crew resource management». The authors suggest approaches to solution of main problems in assessment of efficiency of interaction in the aircraft crew, and to realization of suggested solutions. The article continues previously discussed topic (see World of Transport and Transportation Vol. 12, 2014, Iss. 5; Vol. 14, 2016, Iss. 1; Vol. 15, 2017, Iss. 3).

Keywords: civil aviation, flight safety, CRM, special software, methodological follow-up.

Background. *Publications of different years of publication [1–3] have considered possible approaches to reducing of negative impact of human factor on flight safety. Some researchers of St. Petersburg State University of Civil Aviation [3–12] consider correct composition of aircraft crews as one of possible means. Whereas this approach seems promising, it is unreservedly rejected by aviation community. Therefore, attention, following the course of dominating trends, focuses first on the programs of Crew Resource Management (CRM).*

The basic version of the software «CRM Russia» [3, 13] in the mi-2000s was due to economic reasons transformed into «CRM – two-man resource management». Computer software intended to directly assess efficiency of interaction between two pilots became its inherent component. Particularly, one of the authors of the present article (Evgeny V. Vlasov) developed special software package (SSP) [14].

That SSP and relevant tutorial materials were implemented into training process. But practices of training revealed problems of methodical character:

- *absence of personalization and of account of individual results;*
- *absence of common data storage base;*
- *absence of automated system of processing of results;*
- *weak control of trainees' actions.*

Objective. *The authors' objective is to analyze problems related to application of special software package «CRM – two-man crew resource management» intended for training civil aviation personnel and to suggest efficiency-focused solutions.*

Methods. *The authors use statistical analysis, modelling (particularly ER-modelling), methods of computer engineering, syllabus content analysis.*

Results. *Let us consider in a more detailed manner the above-mentioned tutorial and methodic problems and possible solutions. First, as SSP consisted, to be exact, of independently executed modules, it was decided to combine them into single graphic environment, containing fundamental information on CRM program, and the description of all exercises making part of the program. As each exercise records the results of its execution itself, independently of other applications, comparison of the success of the trainees become the object of responsibility of a trainer, thus making the task rather difficult. It is particularly difficult, if provided that there are no data on the trainees, either on the composition of pairs of trainees, executing the task. So it becomes problematic to assess a given trainee in the context of different exercises and pairs.*

This fact is supported by the correlations, revealed between different indices, and shown in tables 1 and 2 [8].

Table 1

Correlations, revealed between indices Ч_{04}, N, T_{Ring}, T_{Azef}, Ш_1 and Ш_2, during the monitoring of 52 pairs of participants in the test

1st value / 2nd value	Ч_{04}	N	T_{Ring}	T_{Azef}	Ш_1	Ш_2
Ч_{04}		-0,3029	-0,2302	-0,1489	-0,1091	0,1108
N	$P > 0,95$		-0,0739	0,0666	-0,0933	-0,0096
T_{Ring}	$P \leq 0,95$	$P \leq 0,95$		0,0508	-0,0468	-0,1147
T_{Azef}	$P \leq 0,95$	$P \leq 0,95$	$P \leq 0,95$		-0,0868	-0,0131
Ш_1	$P \leq 0,95$	$P \leq 0,95$	$P \leq 0,95$	$P \leq 0,95$		0,7516
Ш_2	$P \leq 0,95$	$P \leq 0,95$	$P \leq 0,95$	$P \leq 0,95$	$P > 0,999$	

Table 2

Correlations revealed between indices $ъ_{04}$, N, T_{Azef}, $N_{ош.}$, $ш_1$ and $ш_2$, during the monitoring of 62 pairs of participants in the test

1st value / 2nd value	$ъ_{04}$	N	T_{Azef}	$N_{ош.}$	$ш_1$	$ш_2$
$ъ_{04}$		-0,1808	-0,0646	0,0133	0,0079	0,0903
N	$P \leq 0,95$		-0,0175	0,1058	-0,2429	-0,0877
T_{Azef}	$P \leq 0,95$	$P \leq 0,95$		0,1386	-0,0711	-0,0576
$N_{mist.}$	$P \leq 0,95$	$P \leq 0,95$	$P \leq 0,95$		-0,1879	-0,2101
$ш_1$	$P \leq 0,95$	$P \leq 0,95$	$P \leq 0,95$	$P \leq 0,95$		0,7188
$ш_2$	$P \leq 0,95$	$P \leq 0,95$	$P \leq 0,95$	$P \leq 0,95$	$P > 0,999$	

To the right and at the top there are Pearson correlation coefficient values between those efficiency rates, and to the left and at the bottom there are features of validity of correlation.

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The Tables 1 and 2 use the following denominations [8, 14]:

• T_{Azef} = Tretention.F – time of retention of the «reference level» within allowable limits;

• T_{Ring} – time of passing by controlled object of a given trajectory;

• $N_{mist.}$ – number of mistakes committed during 300 sec;

• $ш_1$ – mean score of two examinees for exercise «CrossCheck 2» (worst result);

• $ш_2$ – mean score of two examinees for exercise «CrossCheck 2» (best result).

As it can be seen from the tables the time of retention of the «reference level» within allowable limits (T_{Azef}) during exercise Azef demonstrated high discrepancy with other results. The task of that exercise is to develop anticipation of the pilot. Being very useful for training and warm-up that exercise is too sensible to accidental errors and this reduces considerably its capacity from the point of view of diagnosing efficiency of interaction.

The spread of results in exercise «Ring-2», which is rather effective itself, is low [8, 14], and that causes numerous fluctuations in comparatively small groups and complicates comparison of the data achieved with psychodiagnostics data.

Exercise «CrossCheck 1» is a task aimed at developing cognitive and motorial interaction in the two-man crew under the mode of cross control and evaluation of its effectiveness. Tables 1 and 2 show that the results of that exercise have reliably overlapped almost all the experiment results, except for the results of Azef exercise. But here we come across another problem. More aged examinees experience difficulties linked to the use of personal computer. Even they have excellent reaction and excellent teamwork, they have insufficient level of motorial skill of the use of input/output devices, that negatively influences the time of exercise accomplishment and the result. (More simply, aged pilots experience problems to find necessary symbols on the keyboard). This problem is almost not relevant for younger generation of pilots, and since there is a need for additional correlation of the test results and of the age of examinees [8, 14].

Therefore, a set of issues complicates the use of modules in autonomous mode without system proceeding. The problem can be solved by implementation of centralized data store regarding students' data and results of all accomplished exercises.

Pic. 1 shows entity-relationship model (ER-model) [15] of a database, the main entities of which are [14]:

• users – table of students, that is used to store the lists of students trained within CRM program, and to authenticate them in the system;

• sessions – table of users' sessions. When two users enter the system at the same PC to do exercises, a session is created that stores identifications of users and different additional information;

• stealth, ring, azef etc. – tables of results of exercises done. Tables store identification of the session, during which each exercise is done, and the results of exercises.

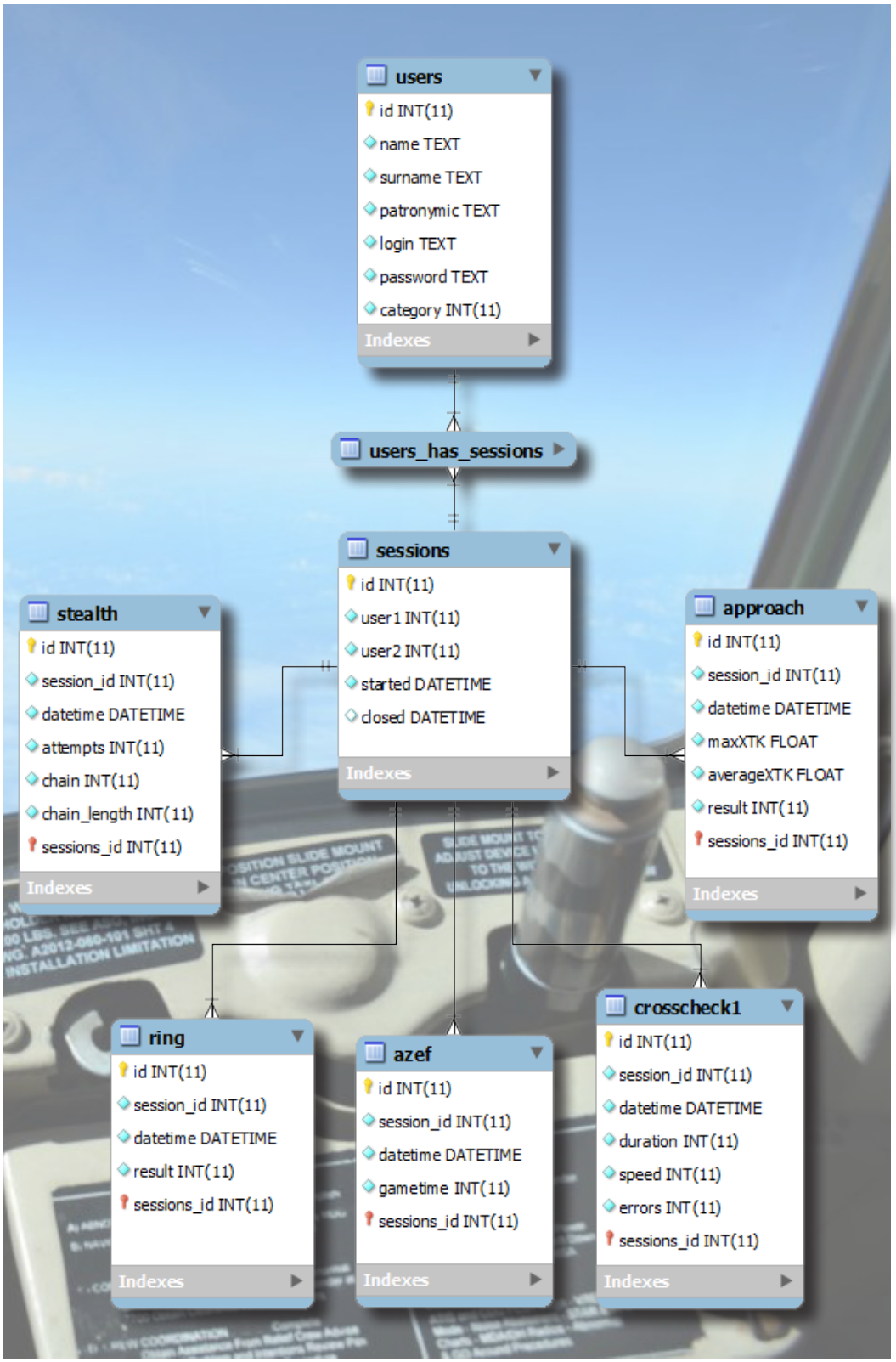
Relations of the model:

• relation «many-to-many» between entities «users» and «sessions» reflects the fact of existence of multitude of sessions for a user (probably with different partners), as well as the fact of participation in each session of more than one user;

• relation «one-to-many» between tables of results and a table of users' sessions reflects the fact of belonging of each result to the given session, and the fact of a possibility to proceed with multitude of different exercises during a single session.

Conclusions. Centralized data store facilitates solving the problem of collection of the results of exercises, and the personalized system of access to the system together with the mechanism of sessions allows easy obtaining the results of any student and their analyzing in the context of different exercises and composition of different pairs of students. The suggested system of audit is a basis for automated procedure of assessment of passing by a student of the program «CRM – two-man crew resource management».

We can name another important problem that was absence of a concept how to divide the



Pic. 1. Simplified ER-model of a suggested database [14].

operation modes of SSP into a training mode and examination mode. We assume that training mode excludes any limitations and provides for a possibility to stop an exercise at any time and to resume it. Examination mode limits freedom of action, does not allow examinees to resume the exercise if they have an opinion that they are fulfilling it with errors. Reduction of the number of examination attempts will result in growing adequacy of the results which are used for assessment.

Our general opinion is that development of special software that is used in the framework of training in CRM program will permit to increase the interaction within the crew, and to achieve that objective it is advisable not to neglect any, even smallest possibility.

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Information about the authors:

Arinicheva, Olga V. – Ph.D. (Eng), associate professor at the department of flight operations and professional training of air personnel of St. Petersburg State University of Civil Aviation, St. Petersburg, Russia, 2067535@mail.ru.

Vlasov, Evgeny V. – senior software engineer of the division of flight simulators of NITA ltd., St. Petersburg, Russia, jeka.vlasov@gmail.com.

Grehov, Vadim A. – graduate pilot of the faculty of flight operations of St. Petersburg State University of Civil Aviation, St. Petersburg, Russia, mrvadim1@mail.ru.

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